Nonlinear Vibration in Powertrain Systems Induced by Friction Couplings

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AUTHOR'S DECLARATION

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

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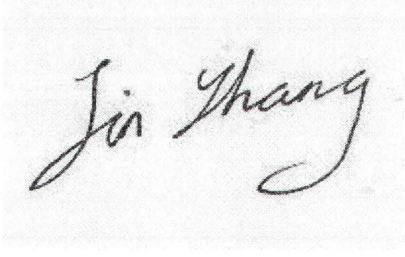

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ABSTRACT

The friction related noise and vibrations are concerned by all researchers and engineers in the automotive field. These vibrations widely exist within brakes, clutch discs and bearings affecting the vehicles' dynamic performance. These friction caused vibrations can even undermine the vehicle safeness. Vehicle powertrain system is treated as a multi-body system combining the transmission characteristics (transmission gear ratio, gear backlash and shifting process). The model and methodology has been developed to perform both linear and transient analysis to identify its dynamics. The focus of this thesis is on the friction induced vibration within vehicle powertrain systems. These vibrations are commonly non-linear and less researched before. The stick-slip behaviour within brake and rotor sub-system is studied through a piecewise linear function. The system dynamics and its impact is studied. Various stick-slip motions are found based on carefully designed criteria. Simulation and analytical results both are used to verify each other. One-Way clutch is another friction mechanism widely used in mechanical systems. A thorough study is carried out in this thesis to investigate the dynamic responses of systems with OWC. Numerical and analytical results prove that, as OWC is not always engaged, and its transition introduces new transients into system dynamics. The experimental works are carried out on UTS powertrain test rig. The stick-slip phenomenon between driving tires and flywheels are visually verified from the observed noise and wear on the driving tires.

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